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**Forrest et al.**

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(54) **QUICK—DISCONNECT FASTENING SYSTEM**

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**F16B 45/00** (2013.01)

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**15/005**  
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(56) **References Cited**

**U.S. PATENT DOCUMENTS**

1,201,295 A 10/1916 Hendee  
1,512,653 A 10/1924 Tinnerman  
2,137,929 A 11/1938 Tinnerman

(Continued)

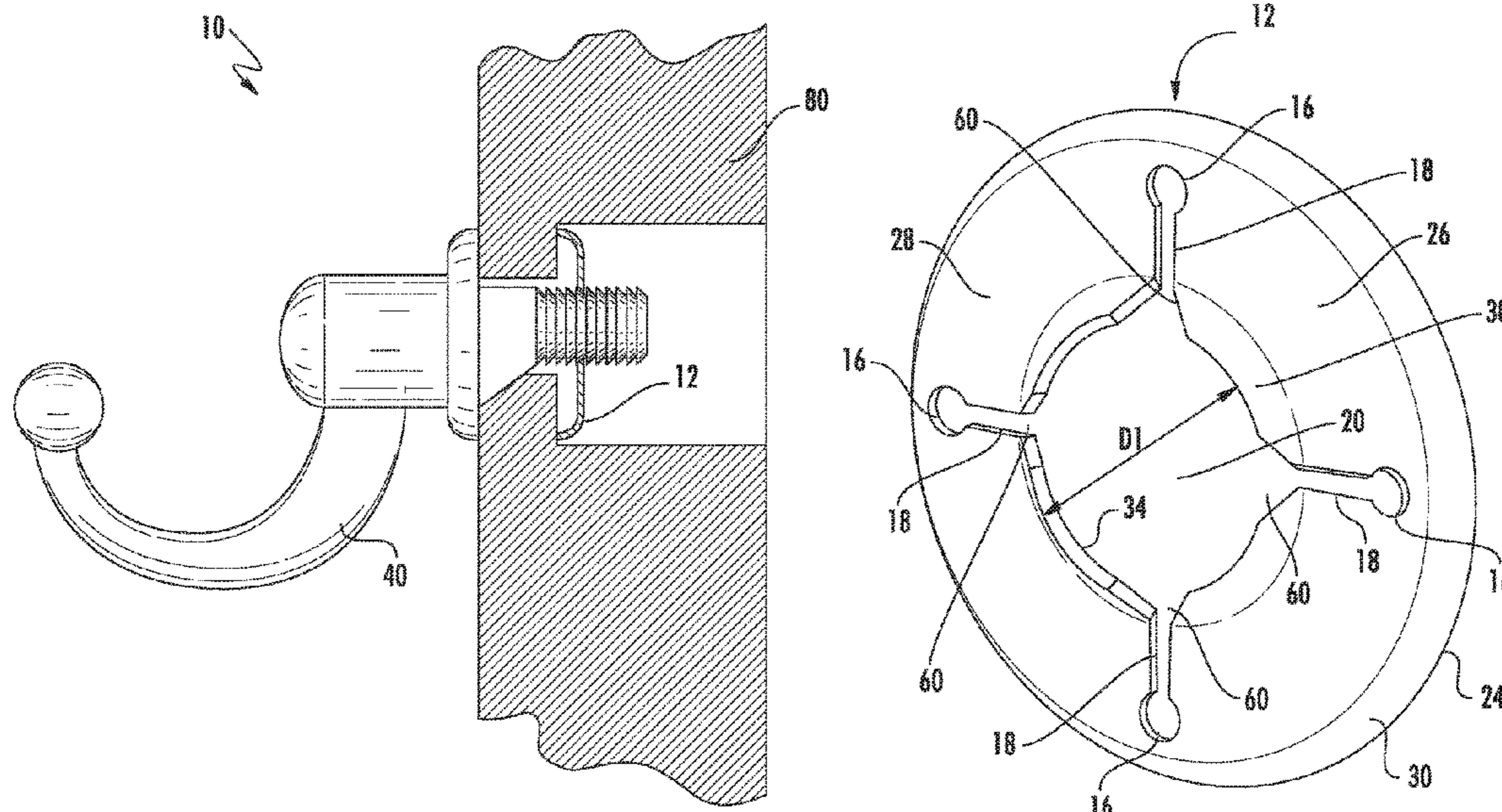
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(57) **ABSTRACT**

A fastener assembly is provided having a cylindrical shank with a plurality of annular grooves formed along a length of the shank. A plurality of elongated ribs extends perpendicular to the grooves along the length. A fastener disc is provided with a central opening with a diameter less than a cylindrical shank diameter wherein an inner edge of the central opening includes a contact surface. The fastener disc is retained on the fastener portion in a locked position when the contact surface engages one of the plurality of grooves with a friction fit. The fastener disc is rotated to a release position so that the elongated rib contacts the inner edge thereby releasing the contact surface from the grooves.

**20 Claims, 10 Drawing Sheets**



(56)

References Cited

U.S. PATENT DOCUMENTS

2,373,312 A	4/1945	Hughes		6,368,319 B1	4/2002	Schaefer	
2,374,426 A	4/1945	Diederich		6,568,893 B2	5/2003	Le Vey et al.	
2,492,115 A	12/1949	Crowther		6,676,350 B1	1/2004	McSherry et al.	
2,552,066 A	5/1951	Sorensen		7,377,735 B2 *	5/2008	Cosenza .....	F16B 43/00
2,929,474 A	3/1960	Boardman					411/521
2,979,794 A	4/1961	Bartolo		D580,616 S	11/2008	Bizzell et al.	
3,099,456 A	7/1963	Hopp		7,613,012 B2	11/2009	Hung et al.	
3,141,211 A	7/1964	Blake		8,177,455 B2	5/2012	Zirin et al.	
3,855,895 A	12/1974	Francis		8,376,679 B2 *	2/2013	Gaudron .....	411/509
4,204,566 A	5/1980	Kirrish et al.		8,506,224 B2	8/2013	Cosenza et al.	
4,844,677 A	7/1989	Schwartzman		8,926,244 B2	1/2015	Sasaki	
4,866,816 A	9/1989	Caveny		9,140,285 B2	9/2015	Burton	
5,207,535 A	5/1993	Saab		2005/0226701 A1 *	10/2005	Craven .....	F16B 35/048
5,520,490 A *	5/1996	Perach .....	F16B 21/16				411/399
			403/259	2010/0129144 A1	5/2010	Osborne	
5,620,290 A	4/1997	Homfeldt et al.		2011/0164944 A1 *	7/2011	Hughes .....	F16B 35/065
5,868,537 A	2/1999	Latal et al.					411/393
D445,980 S	7/2001	Tjugum		2012/0294693 A1 *	11/2012	Gonciarz .....	F16B 25/0063
6,352,439 B1 *	3/2002	Stark .....	F16L 37/008				411/387.1
			439/142	2014/0115861 A1	5/2014	Mellis	
				2015/0167728 A1	6/2015	Bizzini	
				2021/0010503 A1 *	1/2021	Forrest .....	F16B 21/073

\* cited by examiner



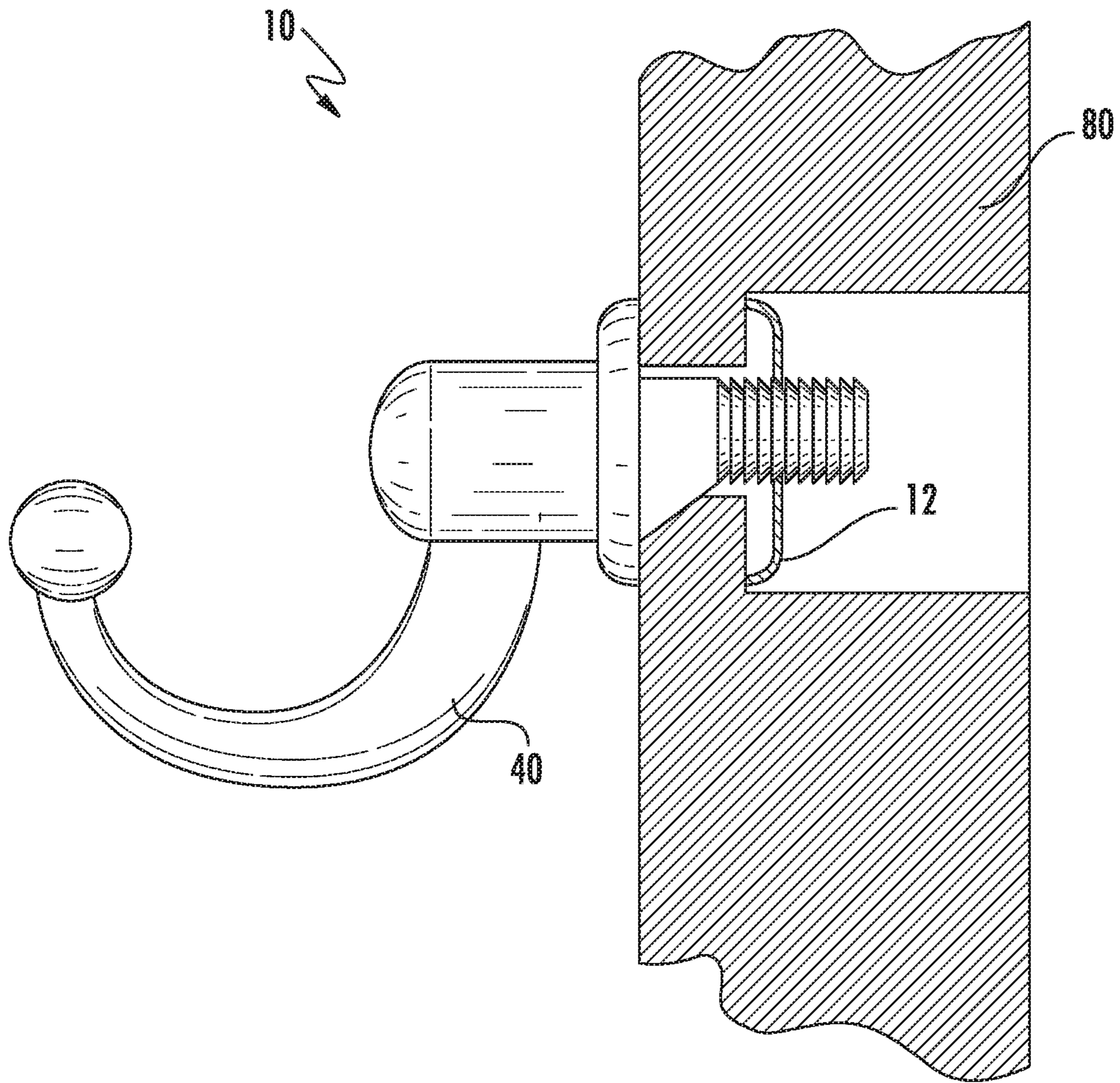


FIG. 1

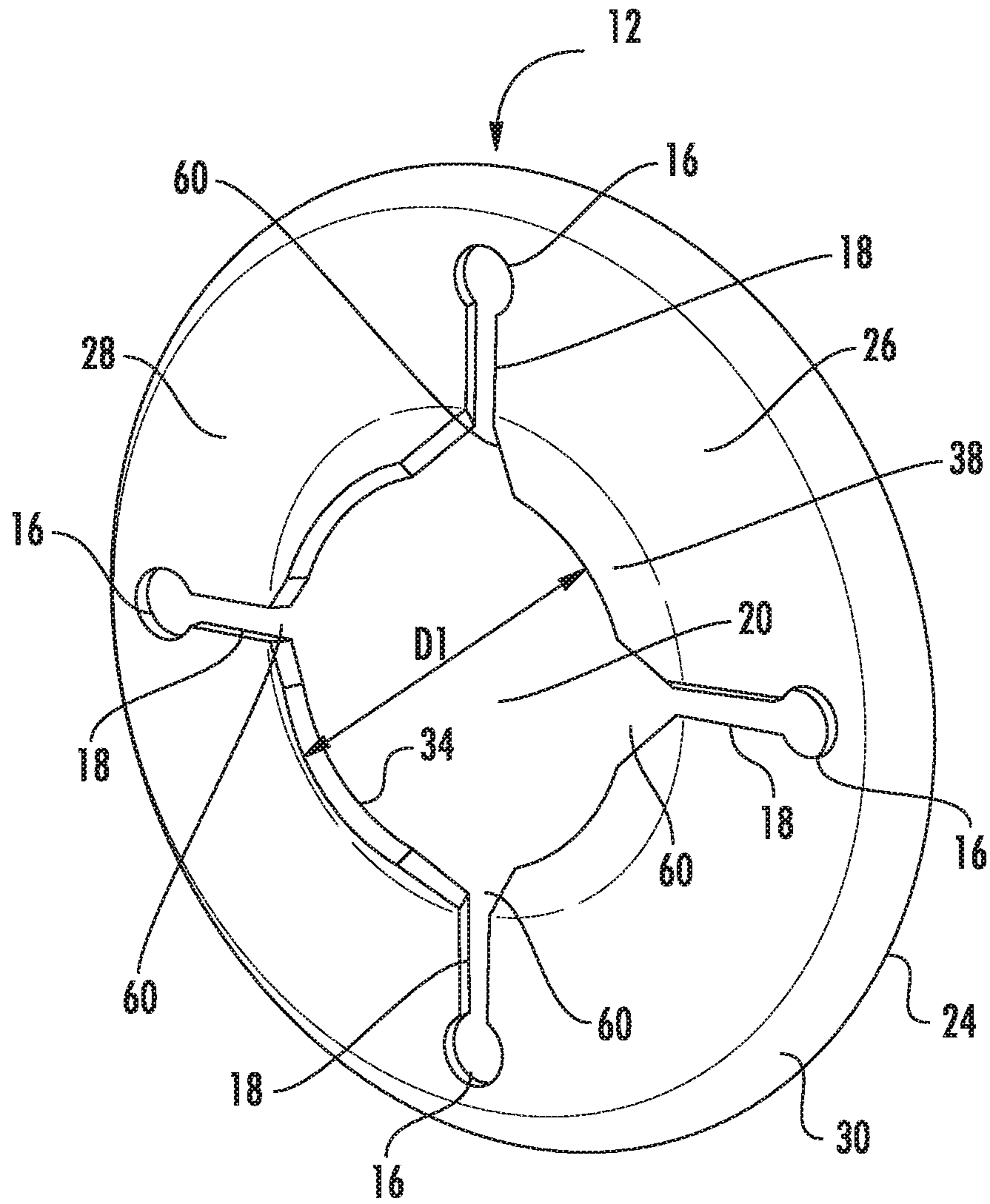


FIG. 2

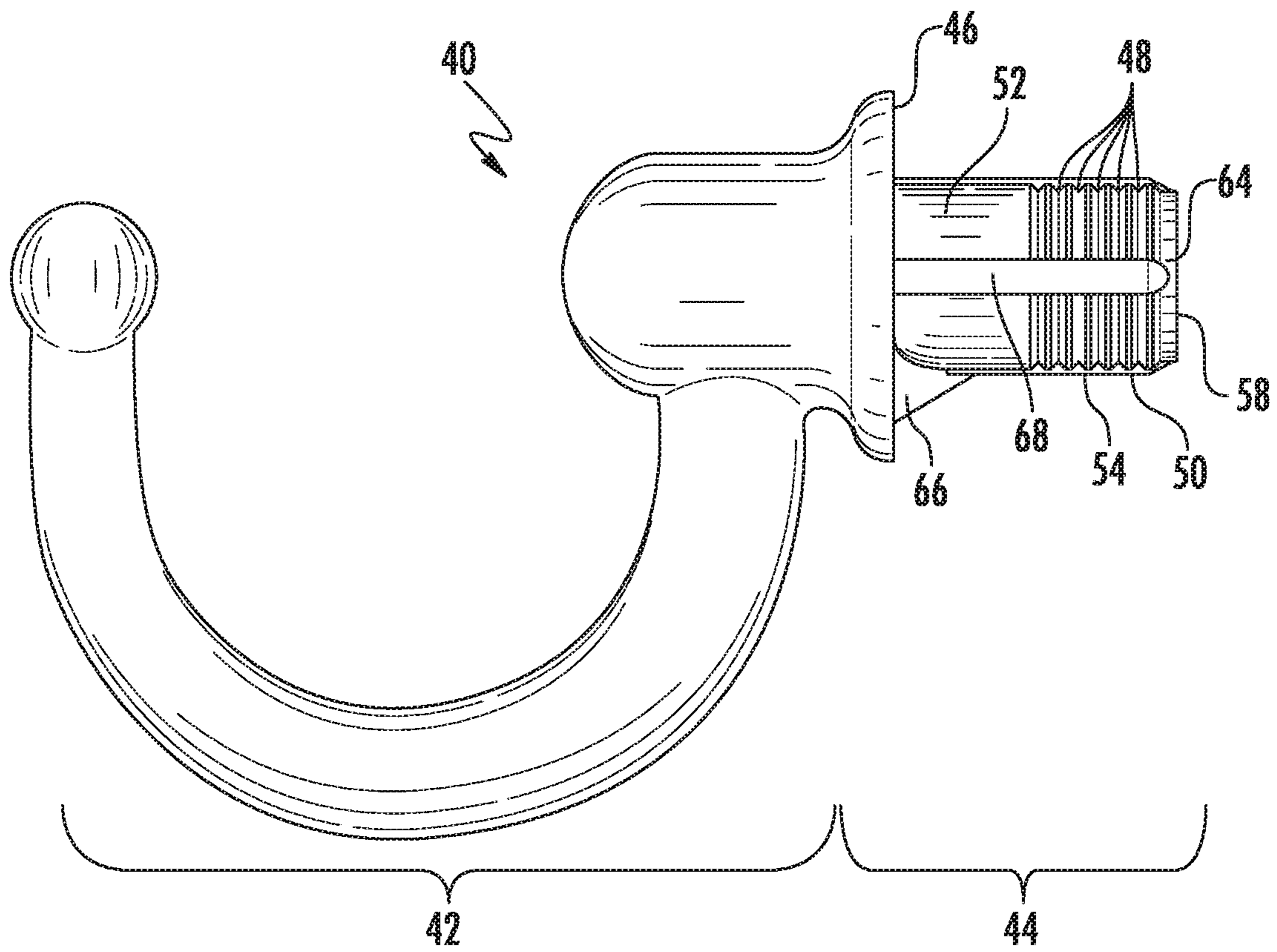


FIG. 3

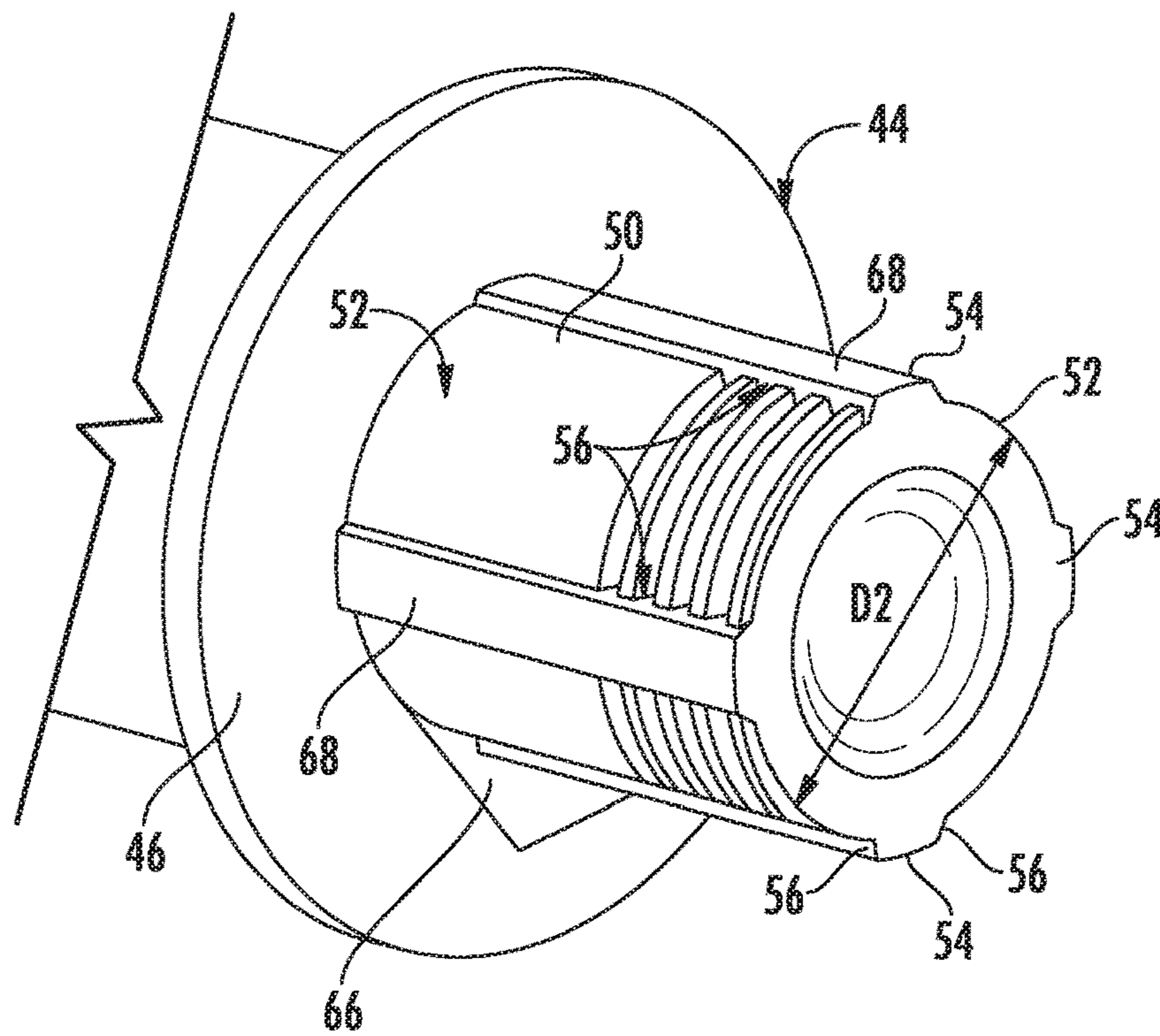


FIG. 4

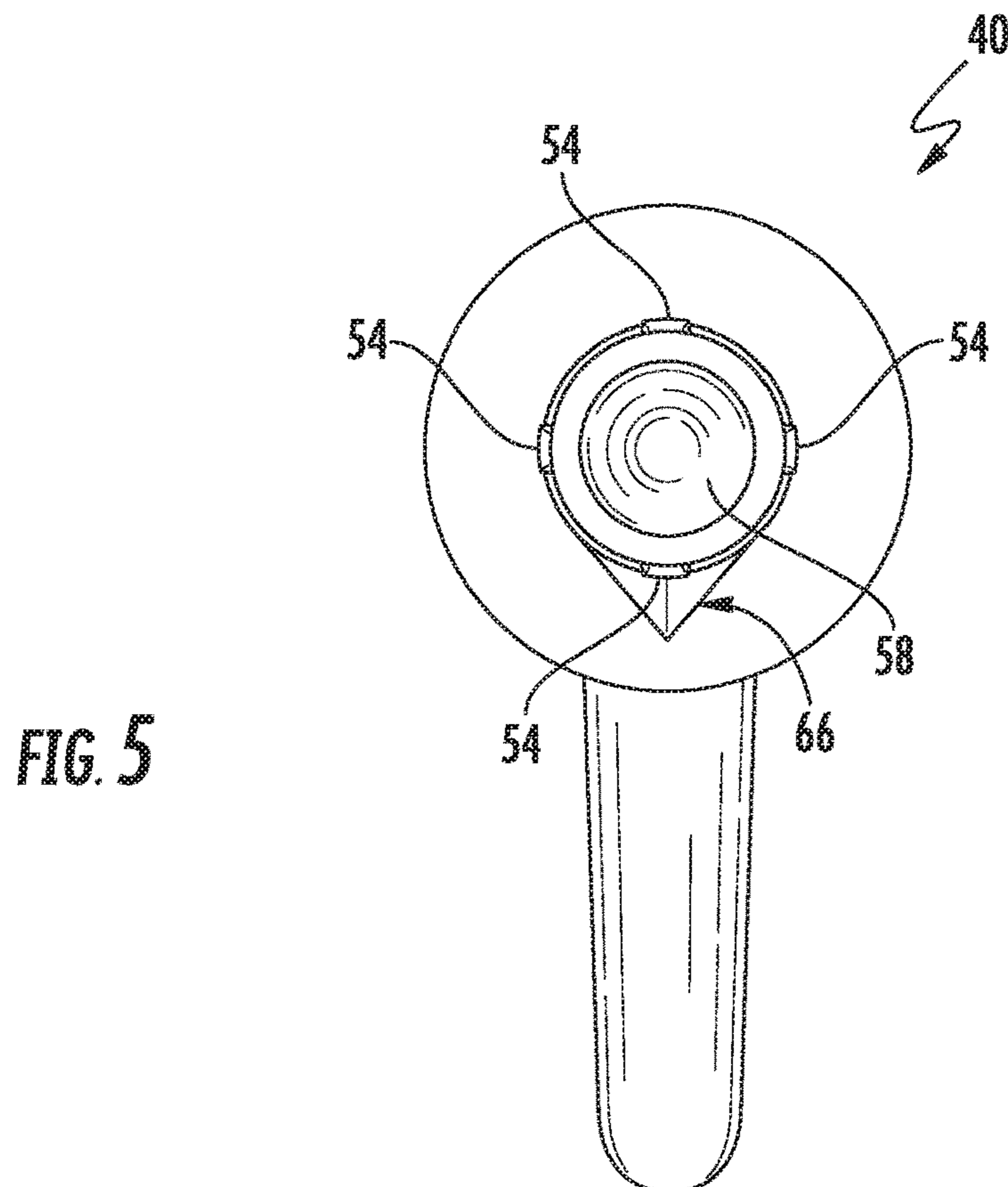


FIG. 5



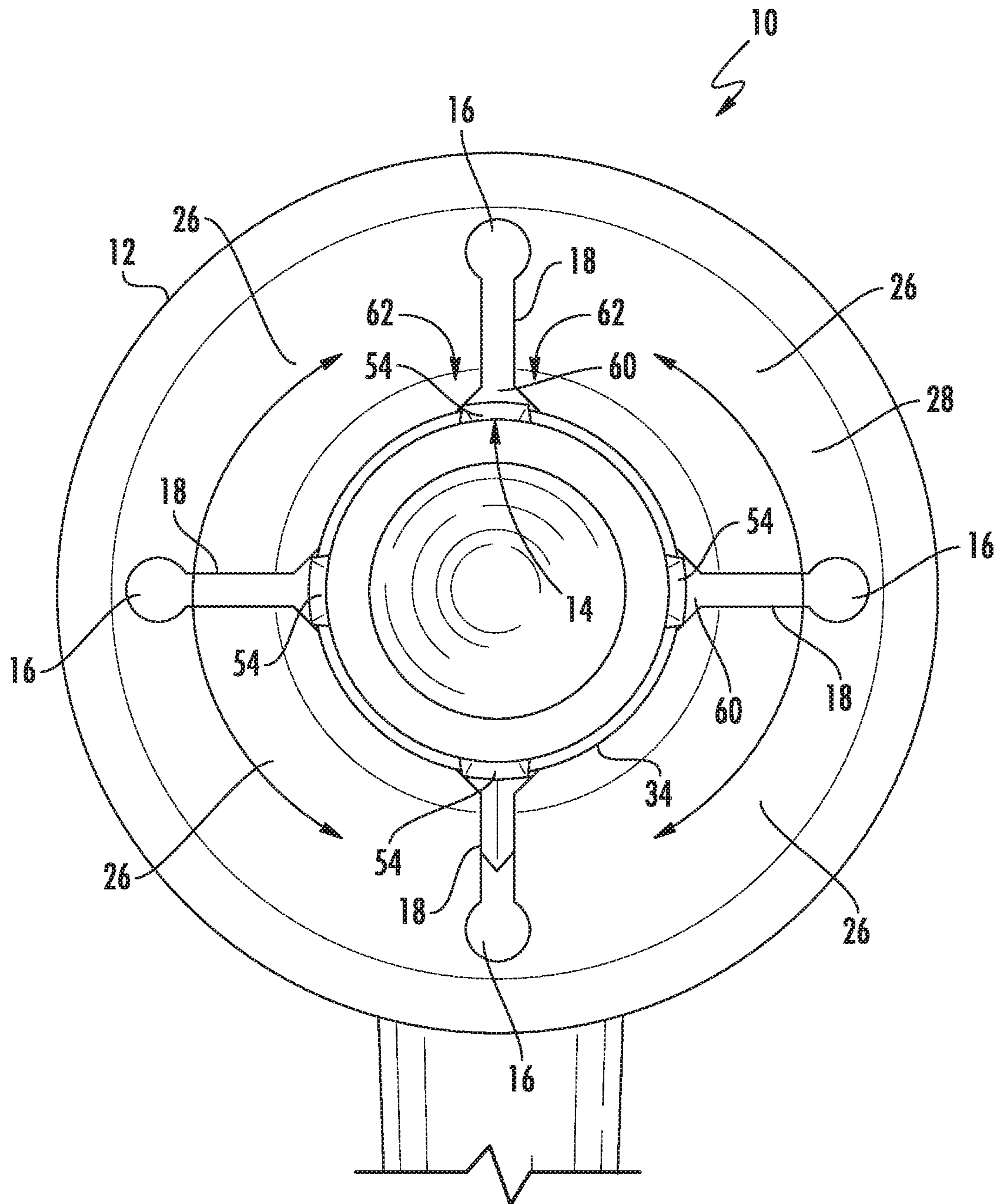


FIG. 6

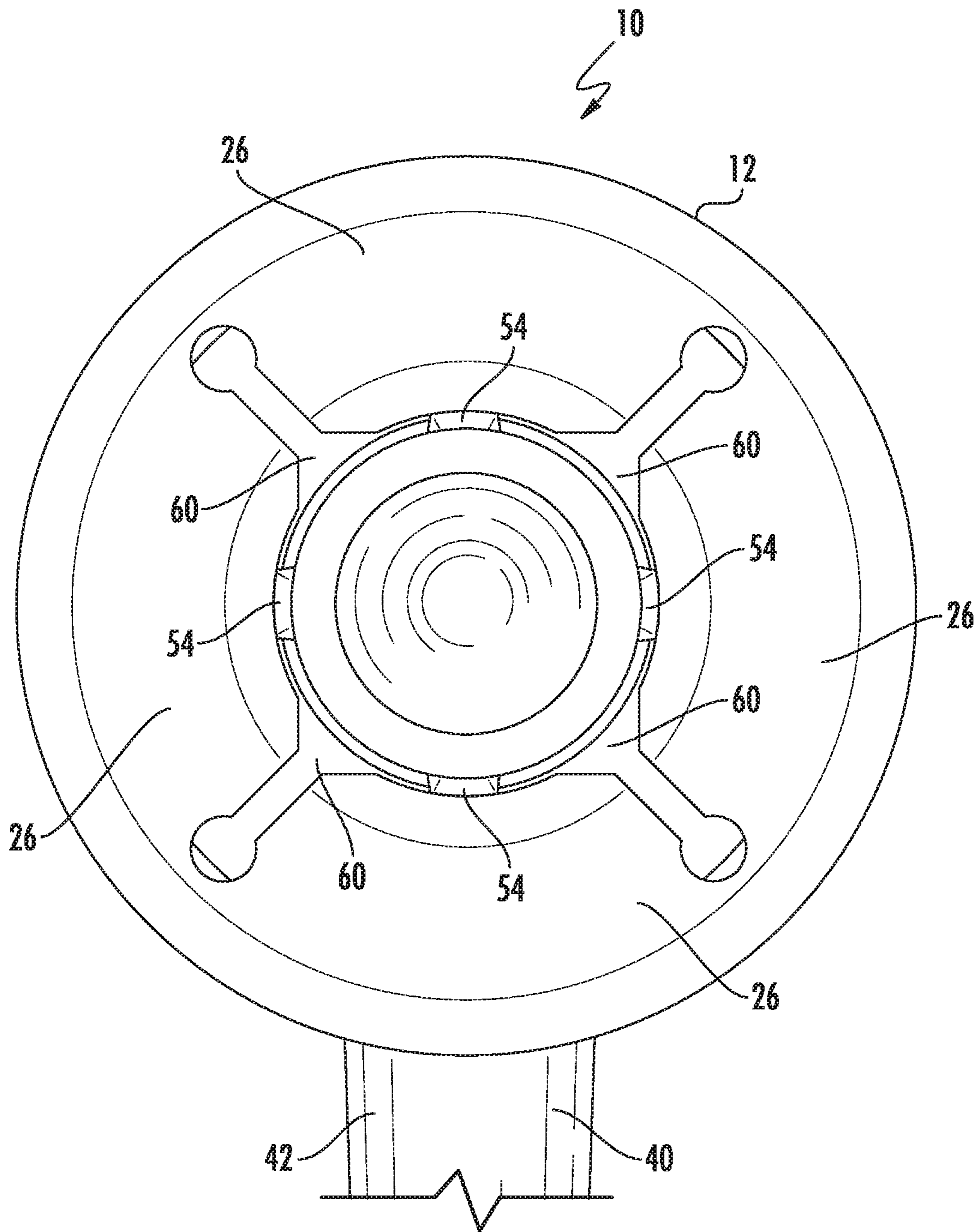


FIG. 7



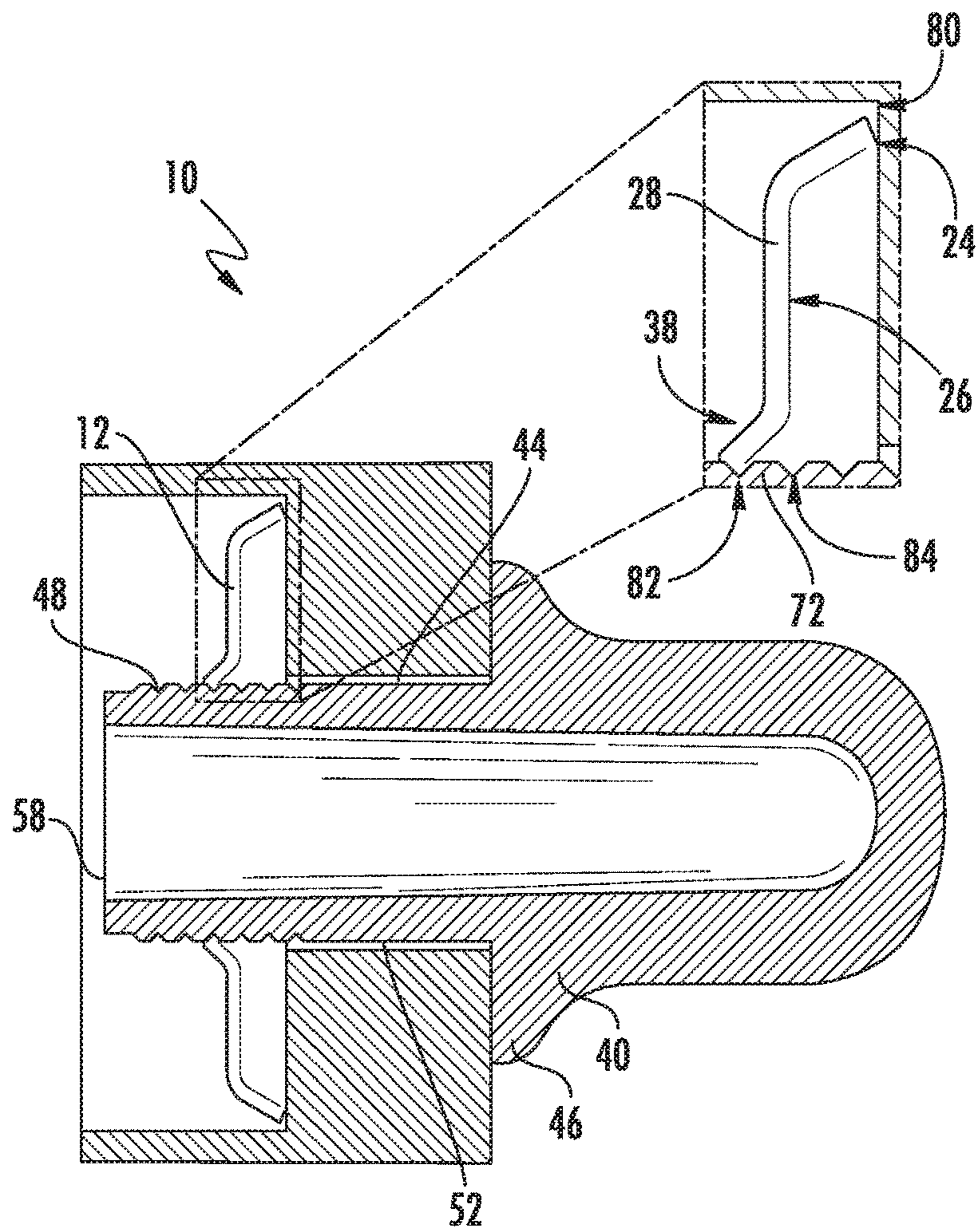


FIG. 8

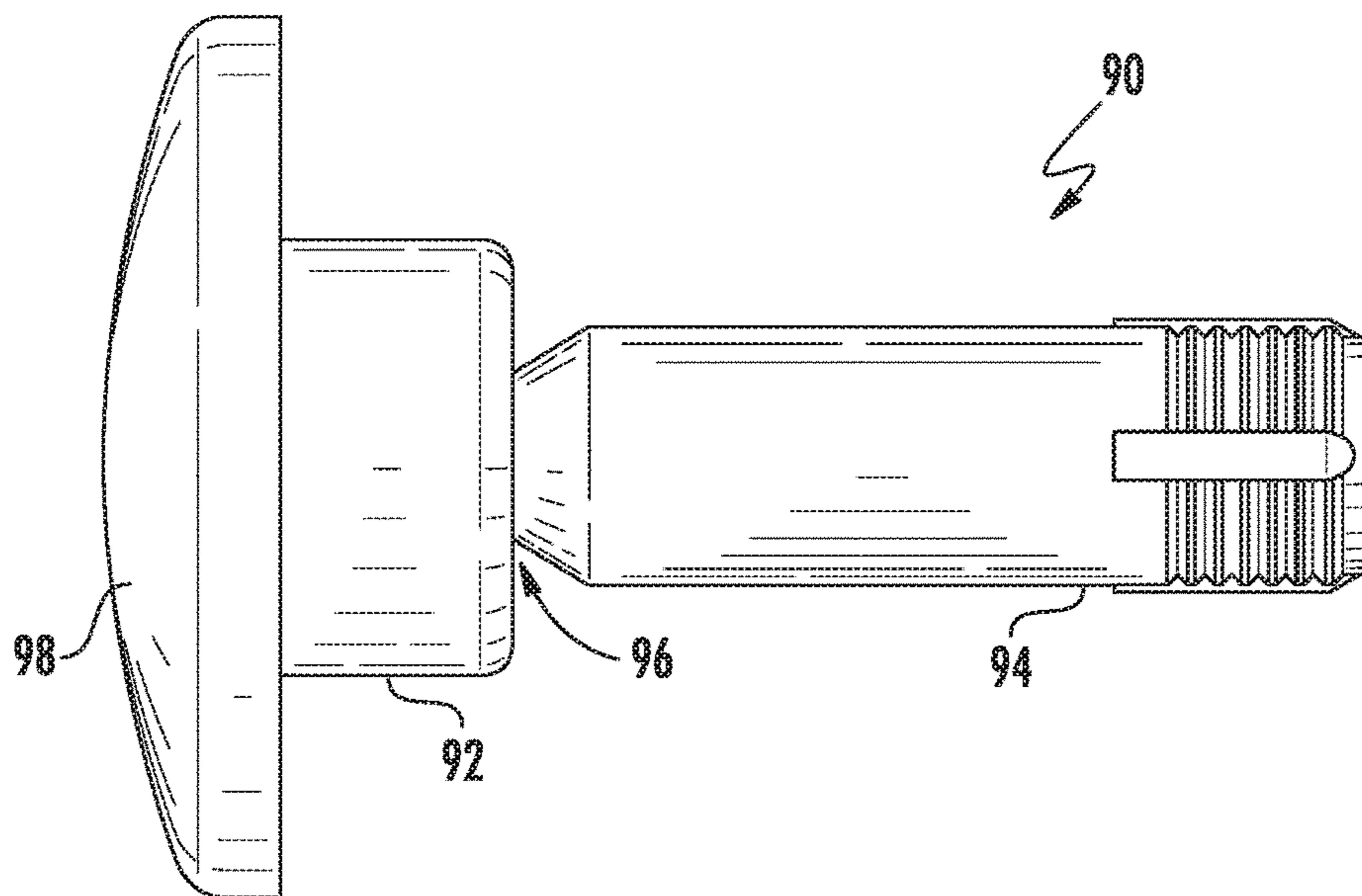


FIG. 9

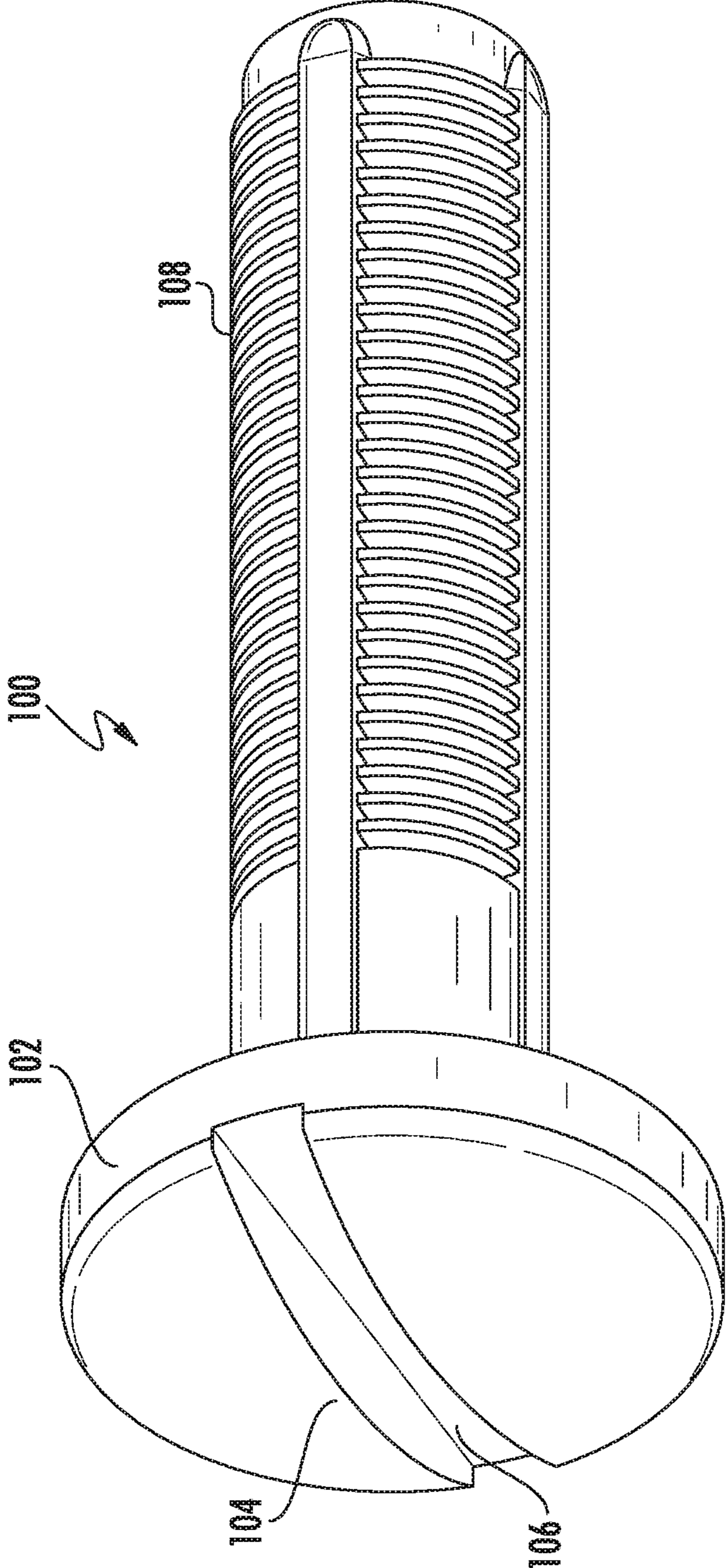


FIG. 10

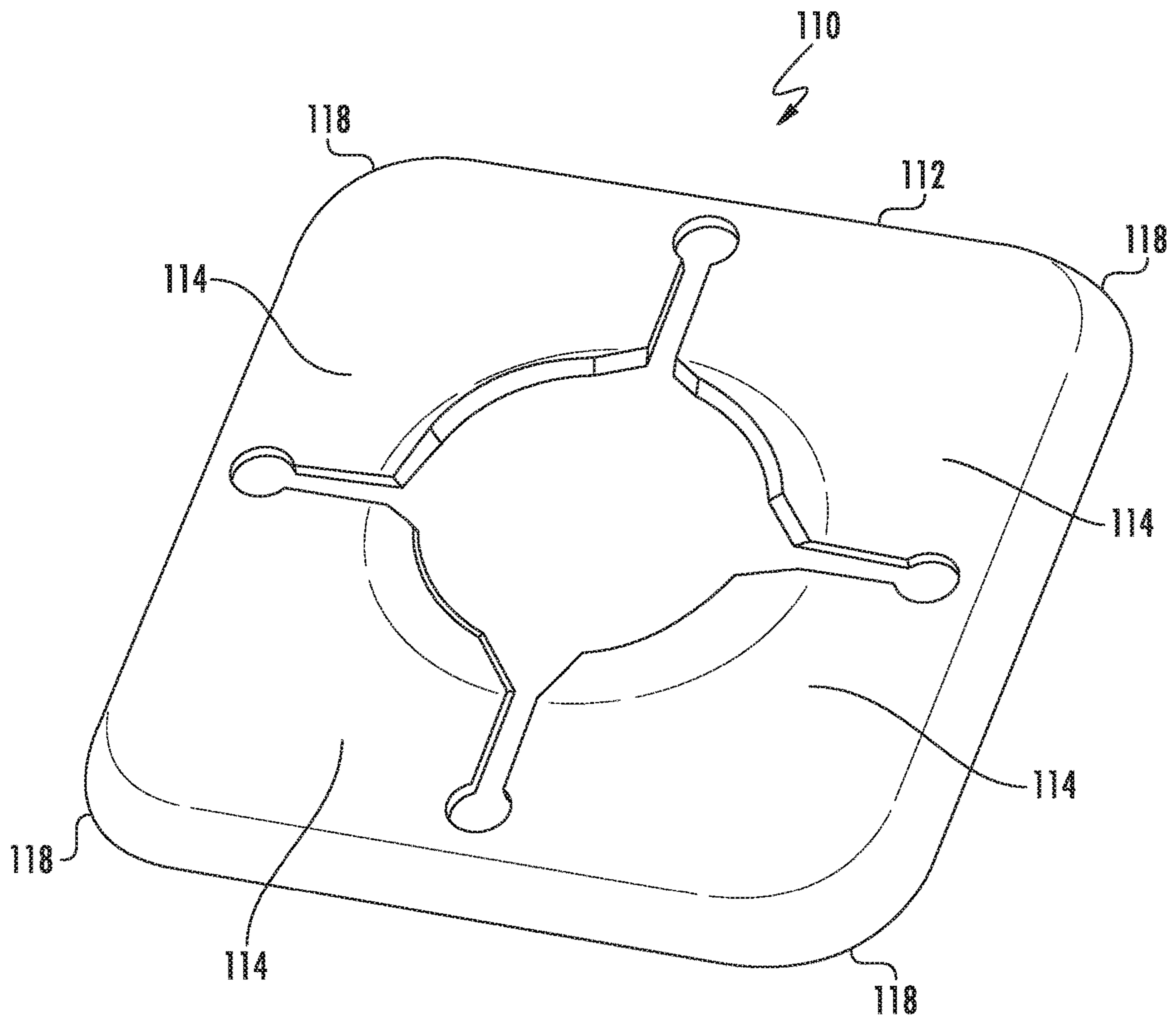


FIG. 11



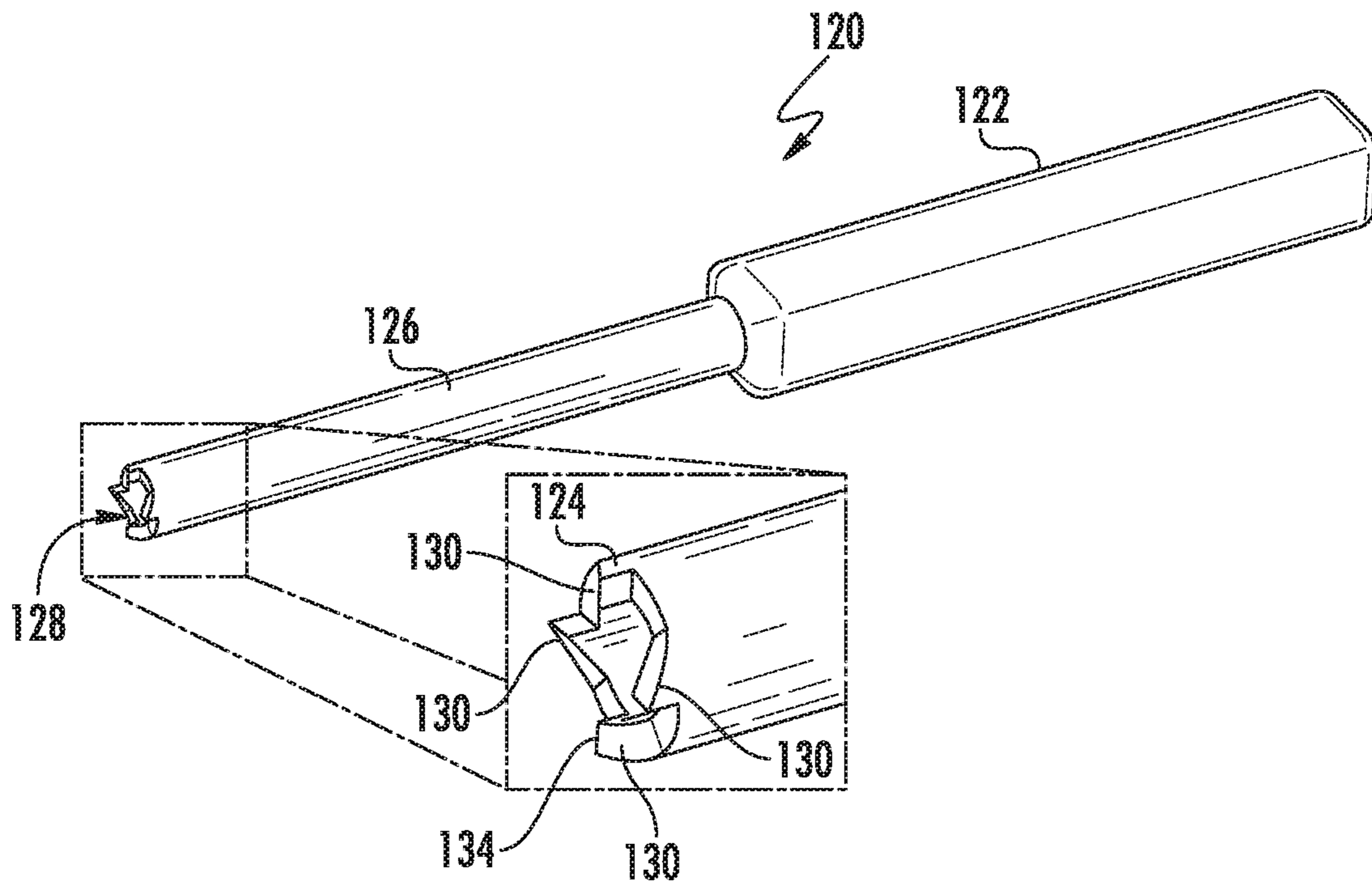


FIG. 12

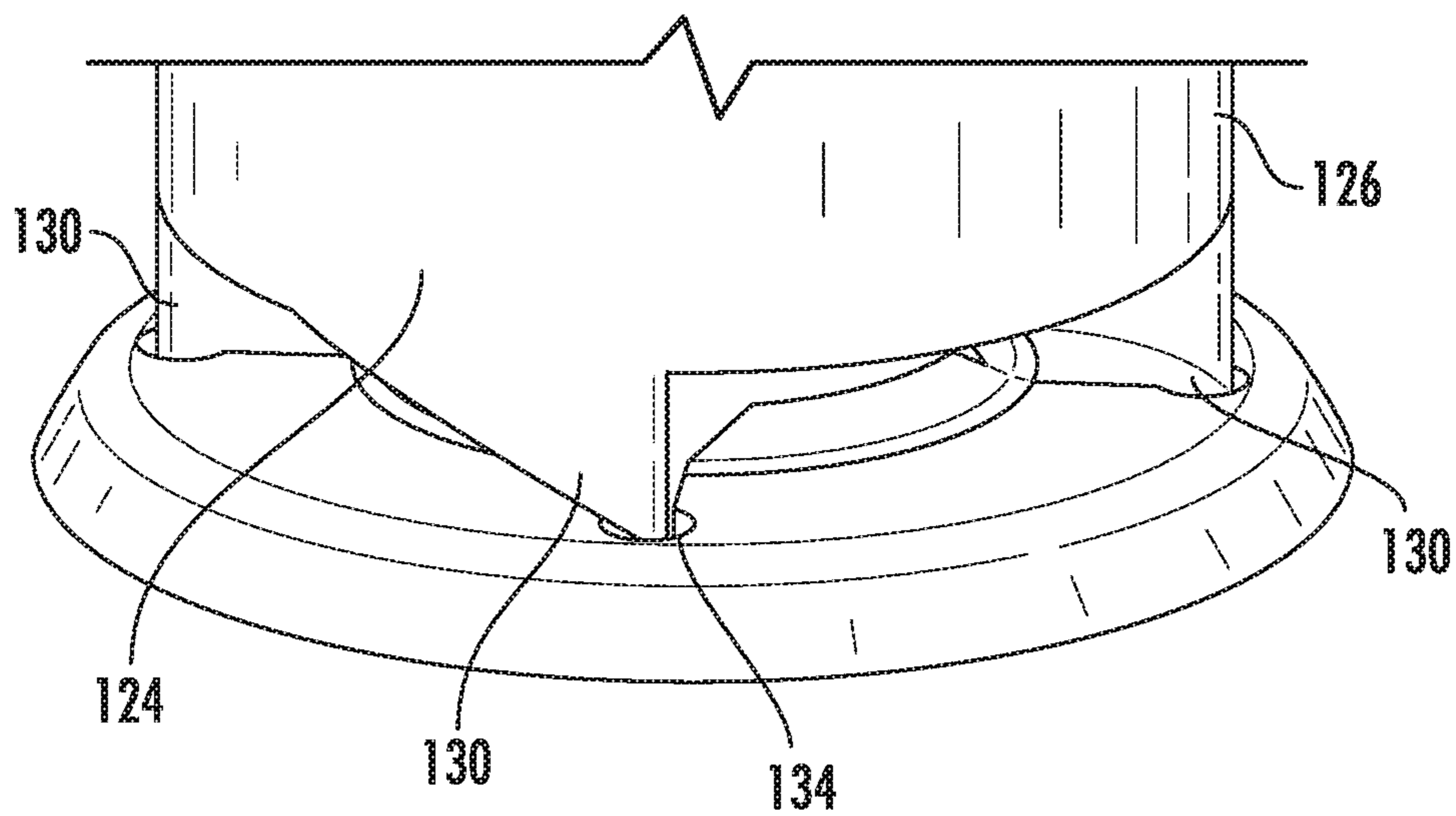


FIG. 13

## QUICK—DISCONNECT FASTENING SYSTEM

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/248,396 filed Jan. 15, 2019, now issued as U.S. Pat. No. 10,788,070, which is a continuation of U.S. patent application Ser. No. 15/296,748 filed Oct. 18, 2016, now issued as U.S. Pat. No. 10,215,213, which claims the priority of Indian application no. IN 201611033994 filed Oct. 4, 2016, the disclosures of which are hereby incorporated in its entirety by reference herein.

### TECHNICAL FIELD

The present application relates to a fastening system that provides for quick disconnection.

### BACKGROUND

Prior art fastening systems for hook rails typically have a rail and at least one hook attached to the rail by way of a threaded hole in the back of the hook and a corresponding threaded fastener. Other fasteners such as quarter-turn fasteners and cable ties offer a means of attaching one or more components to another and to provide retention and locking.

### SUMMARY

According to one embodiment, a fastener assembly is provided having a cylindrical shank with a plurality of annular grooves formed along a length of the shank. A plurality of elongated ribs extends perpendicular to the grooves along the length. A fastener disc is provided with a central opening with a diameter less than a cylindrical shank diameter wherein an inner edge of the central opening includes a contact surface. The fastener disc is retained on the fastener portion in a locked position when the contact surface engages one of the plurality of grooves with a friction fit. The fastener disc is rotated to a release position so that the elongated rib contacts the inner edge thereby releasing the contact surface from the grooves.

In another embodiment, the elongated ribs have drafted sides that act as a cam surface when the disc is rotated.

In another embodiment, in the release position, the rib causes the contact surface to deflect so that the diameter of the central opening is greater than the cylindrical shank.

In another embodiment, a plurality of deflectable tabs is connected to the fastener disc. The contact surface comprises an inner edge of each deflectable tab is defined along the central opening of the fastener disc.

In another embodiment, the fastening disc includes a plurality of slots that project radially outward from the central opening. One of the deflectable tabs is formed between each of the slots.

In another embodiment, the plurality of tabs comprises four deflectable tabs. The fastener disc is turned generally an eighth-turn to the release position.

In another embodiment, a radial opening extends from the central opening and is defined between each of the tabs. The elongated rib is aligned with the radial opening when the disc is in the locked position.

In another embodiment, the fastener assembly includes a disassembly tool, to engage and rotate the disc to the release position.

In another embodiment, the disassembly tool comprises a plurality of teeth, wherein each tooth is shaped to engage a slot between each deflectable tab.

In another embodiment, the disassembly tool grips a peripheral edge of the disc.

In another embodiment, the grooves are defined between the elongated ribs.

According to another embodiment, a quick-disconnect fastener assembly is provided with a mating part with a hardware portion and a fastener portion. The fastener portion is provided with a cylindrical shank with a plurality of annular grooves formed along a length of the shank. A plurality of elongated plateaus extends the length of the cylinder perpendicular to the grooves, the elongated plateaus having drafted sides. A fastener disc is provided with a central opening with a diameter less than a cylindrical shank diameter. A plurality of slots project radially outward from the central opening. A chamfered opening is provided between each of the slots and the central opening. A chamfer angle of the chamfered opening is generally equal to a draft angle of the drafted sides along the plateaus. A plurality of deflectable tabs is provided on the disc, each tab defined between two adjacent slots. An inner edge of each deflectable tab is defined along the central opening. The fastener disc is retained on the mating part when the cylindrical shank is inserted through the central opening so that each of the elongated plateaus is aligned with one of the chamfered openings and the plurality of deflectable tabs is engaged with one of the plurality of grooves with a snap-fit. The fastener disc is disconnected from the mating part by rotation of the disc whereby the elongated plateaus contact the inner edge of the deflectable tabs and release the deflectable tabs from the grooves so that the cylindrical shank is removable from the central opening.

In another embodiment, the hardware portion of the mating part comprises a hook.

In another embodiment, the hardware portion of the mating part comprises a fastener head.

In another embodiment, the mating part comprises a frangible connection for disconnecting the hardware portion.

According to another embodiment, a fastener method is provided. A fastening portion is provided with a cylindrical shank with a plurality of annular grooves formed along a length of the shank and a plurality of longitudinal ribs oriented along the shank that extend perpendicular to and intersect the grooves. A fastener disc is with a plurality of deflectable tabs where an inner edge of each deflectable tab defines a central opening of the fastener disc with a diameter less than a cylindrical shank diameter. The fastening portion is inserted into the central opening disc. The fastening portion is pushed to a locked position where the deflectable tabs are engaged with one of the plurality of grooves with an interference fit.

In another embodiment, the method includes rotating the fastener disc to a release position so that the elongated rib contacts the inner edge of the deflectable tabs to disengage the tabs from the grooves.

In another embodiment, in the release position, the rib causes the contact surface to deflect so that the diameter of the central opening is greater than the cylindrical shank.

In another embodiment, the method includes rotating the fastener disc generally an eighth-turn to the release position.

In another embodiment, a radial opening extending from the central opening and defined between each of the tabs, the



method further comprising aligning the elongated rib is with the radial opening when the disc is in the locked position.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a section view of a quick-disconnect fastening assembly, according to one embodiment.

FIG. 2 illustrates a fastener disc of the quick-disconnect fastening assembly of FIG. 1, according to one embodiment.

FIG. 3 illustrates a mating part of the quick-disconnect fastening assembly of FIG. 1, according to one embodiment.

FIG. 4 is a detailed view of a portion of the mating component of FIG. 3, according to one embodiment.

FIG. 5 is a rear view of the mating part of FIG. 3, according to one embodiment.

FIG. 6 is a rear view of the eighth-turn assembly of FIG. 1 in a locked position.

FIG. 7 is a rear view of the eighth-turn assembly of FIG. 1 in release position.

FIG. 8 is a detailed section view of a portion of the quick-disconnect fastening assembly in the locked position.

FIG. 9 illustrates a mating part of the quick-disconnect fastening assembly, according to one embodiment.

FIG. 10 illustrates a mating part of the quick-disconnect fastening assembly, according to one embodiment.

FIG. 11 illustrates a fastener disc of the quick-disconnect fastening assembly, according to one embodiment.

FIG. 12 illustrates a tool for use with the quick-disconnect fastening assembly, according to one embodiment.

FIG. 13 illustrates the tool of FIG. 12 in use with the quick-disconnect fastening assembly.

#### DETAILED DESCRIPTION

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

Quarter-turn fasteners and cable ties, more commonly known as “zip-ties,” offer a quick and easy means of attaching one or more components to another. In general, these objects utilize a flexible component to engage threads or a set of repeating features at right angles for optimal retention. However, these types of fasteners are difficult to disconnect or are not reusable after disconnection.

FIG. 1 illustrates a quick-disconnect fastening assembly 10. The quick-disconnect fastening assembly 10 utilizes a spring disc 12 to fasten a mating part 40 to a panel 80, just as in a hook-and-rail assembly. The quick-disconnect fastening assembly 10 provides an improved, simplified and low-cost fastener assembly for attaching one object to another. The quick-disconnect fastening assembly 10 is self-locking and provides retention, yet is quickly and easily removable. The quick-disconnect fastening assembly 10 utilizes simplified geometry over the prior art while also including mating geometry that allows quick disassembly when needed. Assembly is accomplished without the need for rotation which can cause repetitive motion injuries in a factory setting where high volumes place a significant burden on assembly workers. Removal of the fastener is

accomplished by rotating the device through an angle of 45-degrees, or an eighth-turn and then pulling at least one of the components in the opposite direction that was needed for assembly. Historically, quick release fasteners required a full 90-degrees, or a quarter turn for both assembly and removal and were thus called quarter-turn fasteners.

FIG. 2 illustrates the spring disc 12 of the quick-disconnect fastening assembly 10. The spring disc 12 contains four through-holes 16 which are connected to four through slots 18. The slots 18 extend radially from a central opening 20 to the through-holes 16. As shown in FIG. 1, a circular peripheral edge 24 is oriented concentrically around the central opening 20, as shown in FIG. 1. However, the peripheral edge 24 may be any suitable shape. The peripheral edge 24 also forms the base of the spring disc 12 that may abut a mounting surface.

The spring disc 12 may be formed of metal and produced using a high-speed stamping process. This process also allows the spring disc 12 to be produced in high volumes at relatively low cost. The disc 12 may be made from a grade of spring steel. Alternatively, the disc 12 may be formed of suitable injection molded polymeric material using a multi-cavity mold.

Four flexible tabs 26 are defined between the slots 18. The flexible tabs 26 define a forward surface 28 of the disc 12. The forward surface 28 faces the user as the disc 12 is pushed onto the mating part 40. The forward surface 28 is offset and generally parallel to a mounting surface. The forward surface 28 is connected to the peripheral base 24 by a peripheral surface 30. The peripheral surface 30 may extend generally perpendicular to the forward surface 28. Alternatively, the peripheral surface 30 may be angled outwardly from the forward surface 28 for ease of tooling and reduced stress within the part during assembly and use. The point where these two surfaces 28, 30 meet has a rounded edge, which is also for ease of tooling and reduced stress.

An inner edge 34 of the flexible tabs 26 is allowed to deflect by a distance which is equal to or greater than the wall thickness of the spring disc 12 without exceeding the working limits of the material used. The through-holes 16 help to minimize stresses created as the flexible tabs 26 move toward or away from the peripheral base 24. The through-holes 16 are located radially close to the peripheral surface 30 to allow each of the four flexible tabs 26 to move independently of each other as needed thereby providing the overall tolerance sensitivity of the system. The inner edges 34 of each of the flexible tabs 26 define the diameter D1 of the central opening 20. The flexible tabs 26 allow variations in tolerance by having the diameter D1 equal to or less than a minor diameter of the mating part 40 and thus generating a spring tension between disc 12 and the mating part 40 at full engagement. The flexible tabs 26 have a ramped surface 38 that extends upward from the forward surface 28.

The fastener disc 12 mates or interfaces with the mating part 40, such as a hook illustrated in FIG. 3. The mating part 40 includes a hardware portion 42. As illustrated in FIG. 3, the hardware portion is defined as a hook which is designed for holding keys or may be sized for holding other items. However, the hardware portion 42 may be provided in any suitable configuration such as a peg, knob or other hardware shape.

The mating part 40 also includes a fastener portion 44. The fastener portion 44 of the mating part 40 is typically inserted through a board or panel 80 that forms the rail of the hook-and-rail assembly. The fastener disc 12 is then applied to the fastener portion 44 from the back side of the panel for



a quick and easy means of securing the mating part 40 or other component without the need for threaded holes or threaded fasteners.

With reference to FIGS. 2-4, the fastener portion 44 includes a generally cylindrical shaped shank 50 that projects away from the base 46. The fastener portion 44 includes a plurality of grooves 48 formed along a cylindrical surface 52 of the shank 50. The grooves 48 are formed adjacent a distal end 58 of the shank 50. The grooves 48 may be positioned at various distances from the base 46 to allow for a variety of different panel thicknesses and to allow for normal machining process tolerances of the panel.

The grooves 48 may be v-shaped having symmetrically angled walls that intersect to form the grooves 48. Alternatively, may be asymmetrical, with each groove having a steeper sloped wall closest to the distal end 58 and a moderate sloped wall inboard closest to the base 46. The asymmetrical groove may be formed similar to a ratchet tooth. The grooved cylindrical shank 50 may be die-cast or molded with the mating part 40 thus eliminating the drilling and/or tapping operations required with typical mating components.

Additionally, the cylindrical shank 50 has a plurality of longitudinal ribs 54 that extend the length of the cylindrical shank 50 and are perpendicular to the grooves 48. As shown in FIG. 4-5, the fastener portion 44 includes four raised longitudinal ribs 54 that project radially from the cylindrical surface 52. The longitudinal ribs 54 are elongated plateaus that are evenly spaced apart along the circumference of the cylindrical surface 52. An engagement surface 68 of the longitudinal ribs 54 defines a diameter that is slightly larger than the diameter of the cylindrical surface 52. It should be noted that surface 52 shares the same central axis as the grooves 48. Each of the longitudinal ribs 54 include drafted sides 56 that are formed at an angle other than perpendicular to the cylindrical surface 52. The sides 56 of the longitudinal ribs 54 are drafted for ease of molding and to provide a cam surface for disconnecting the assembly 10.

As shown in FIG. 3, the longitudinal ribs 54 extend along the length of the fastener portion 44 from the base 46 beyond the grooves 48 at the distal end 58. The cylindrical shank 50 includes a lead-in surface 64 adjacent the distal end 58. The lead-in surface 64 is tapered from the cylindrical surface 52 toward the distal end 58. The lead-in surface 64 provides a method of engaging and aligning the mating part with the fastener disc 12. The cylindrical surface 52 shares the same central axis as the grooves 48 and four longitudinal ribs 54. The longitudinal rib 54 may also include a lead-in surface adjacent the distal end 58.

The mating part 40 also includes an anti-rotation feature 66. The anti-rotation feature 66 is formed as a wedge connected between the fastener portion 44 and the base 46. The anti-rotation feature 66 engages a corresponding groove formed on the panel 80 to which the mating part 40 is attached to prevent the mating part 40 from rotating during use and while the disc 12 is be connected and disconnected. Other anti-rotation or keying methods which prevent rotation of the mating part 40 are also possible. FIG. 5 is an end view of the mating part 40 further showing the anti-rotation feature 66 provided for the single point mount hook example.

As illustrated in FIGS. 6-7, the disc 12 includes a chamfered opening 60 where the slot 18 connects to the central opening 20. The chamfered opening 60 is defined by chamfered walls 62 that are oriented at an angle from the walls defining the slot 18 so that the chamfered opening 60 is wider than the slot 18. The chamfered walls 62 are oriented

as mirror images about a central axis of the slot 18. The chamfered opening 60 extend radially from the central opening 20.

FIG. 6 illustrates the rear view of the quick-disconnect fastening assembly 10 where the mating part 40 and the fastener disc 12 are in the fully engaged and locked position. In the locked position 14, one of the chamfered openings 60 is aligned with one of the longitudinal ribs 54. It should be noted that chamfered opening 60 freely clears the four longitudinal ribs 54. Further, as shown in FIG. 6, the angle of the chamfered walls 62 is a generally equal to the angle of the drafted side surfaces 56.

FIG. 8 is a sectional view of the quick-disconnect fastening assembly 10 when the disc 12 is in the fully engaged position with the fastener portion 44 of the mating part 40. During installation, the longitudinal ribs 54 are aligned with the chamfered openings 60 and the cylindrical shank 50 of the mating part 40 is inserted into central opening 20. Since the diameter D2 of cylindrical surface 52 has a diameter that is greater than the diameter D1 of the central opening 20, the flexible tabs 26 expand outward away from the forward surface 28 during engagement. As the flexible tabs 26 expand and deflect, the inner edge 34 clears the first circumference rib 72 and then snaps into first groove 48. With continued force applied to the disc 12, the flexible tabs 26 continue to expand and deflect to be moved past each of the circumference ribs 72 and then snap into place in each of the grooves 48. This process continues until the peripheral base 24 is positioned adjacent to or abutting the panel surface 80.

In the engaged position shown in FIG. 8, the disc 12 is retained on the fastening portion 44 with an interference fit, or sometimes referred to as a friction fit, or snap fit. In the engaged position the inner edge 34 resides in the groove 82. The inner edge 34 of each tab 26 is formed at an angle and engages a wall of the groove closet to the distal end 58 so that any backward motion of the disc 12 will cause the inner edge 24 of the tab 26 to jam against the surface of the groove, thereby preventing any further backward motion and preventing the disc 12 from being removed from the fastener portion 44. The spacing between the grooves 48 and the thickness of the disc 12 is designed such that the yield of the material used to manufacture the disc 12 is never exceeded regardless of position or number of exposed grooves when assembled.

By pushing the disc 12 still further, the inner edge 34 of the flexible tabs 26 will rise up from the first groove 82 and drop into the second groove 84 and thus complete the assembly process with maximum retention. During insertion or assembly, the inner edge 34 of each tab 26 will make an audible sound as the tabs 26 are snap-fit into each of the grooves 48 in rapid succession.

The disc 12 is then easily removable from the fastening portion 44 in two motions; first turning the disc and then pulling the disc 12 or mating part 40. By rotating the fastener disc 12 while the mating part 40 remains stationary, the chamfered walls 62 will make contact with drafted side surfaces 56. Continuing to turn the fastener disc 12 another 45-degrees, or approximately an eighth-turn, will cause the inner edge 34 to climb out of the grooves 48 until the inner edge 34 resides on top of the engagement surface 68 of the four longitudinal ribs 54, as detailed in FIG. 7. In the release position in FIG. 7, the longitudinal ribs 54 deflect the inner edge 34 of each of the tabs 26 so that the diameter of the inner opening 20 is greater than the diameter of the cylindrical shank 50. Once the fastener disc 12 is in the release position in FIG. 7, the mating part 40 can be easily removed from the panel by pulling the mating part 40 or disc 12 to



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remove the disc **12** from the fastener portion. Removing the mating part **40** and allows easy replacement, if so needed.

FIG. **9** illustrates another use of the quick-disconnect fastener assembly **10**. FIG. **9** illustrates a mating part **90** having a releasable hardware portion **92**. For example, when hook-and-rail assemblies are installed by the consumer to a panel, it is desirable to conceal the fastener and fastener holes used to attach the rail to the panel. This is typically accomplished by use of either wood or plastic dome plugs. Also, hook-and-rail assemblies are in some cases sold at retail installed onto cards for purposes of display and typically include marketing materials and instructions on the card. The packaging fasteners used to attach the hook-and-rail assembly to the display card are typically either in the form of a plastic rivet, which can be difficult to remove by the consumer or a plastic wing-nut and bolt combination. The mating part **90** includes a dome plug design which also provides a means of attaching a hook rail to a retail display card.

The hardware portion **92** defines a dome plug **98**. The fastening portion **44** enables the attachment of the hook-and-rail assembly to a display card. Such an approach more accurately shows the buying consumer what the product will look like, once installed. The mating part **90** includes a reduced thickness area **96** between the hardware portion **92** and the fastening portion **94**. The reduced thickness area **96** is frangible to allow the dome plug **98** to be separated from the fastening portion **44**. For example, the hardware portion **92** can be separated by twisting or bending along the reduced thickness area **96** until the hardware portion **92** separates from the fastener portion. The mating part **90** may be formed of polymer material manufactured by injection molding in a color which substantially matches the color of the hook rail.

FIG. **10** illustrates another use of the quick-disconnect fastener assembly **10**. FIG. **10** illustrates a mating part **100** having a hardware portion **102** formed as a fastener head with a standard slot drive configuration in a common round or pan head **104**, as shown. In addition to the slotted drive configuration **106**, the hardware portion **102** may include any number of standard drive configurations including cross-recessed, square recessed, hex, torx, for example. The head **104** is connected to a fastening portion **108** containing features as shown and described above.

FIG. **11** illustrates a disc **110** having a square peripheral edge **112**. The square peripheral edge **112** provides increased rigidity to the flexible tabs **114**. Further, the square disc **110** allows conventional tools to more easily hold and clamp the square peripheral edge **112** in order to turn the disc to disconnect the assembly. If additional rigidity is needed, the flexible tabs **114** may include embossment ribs toward the corners **118**, for example.

FIG. **12** illustrates an installation and removal tool **120** for use with the quick-disconnect fastening assembly **10** for removing the fastener disc **12** from the mating part **40**. The tool **120** may include a hollow square handle **122** for gripping the tool **120**. However, any shaped handle **122** may be utilized. Extending from the handle **122** is an engagement portion **124**. The engagement portion **124** is formed of a hollow round tube **126**. The distal end **128** of the tube **126** contains four engagement teeth **130**. The four engagement teeth are spaced apart evenly around a circumference of the hollow tube **126**. Each of teeth **130** has an engagement surface **134** that are oriented radially and perpendicular to the circumference of the hollow tube **126**. The engagement surfaces are inserted into the four through slots **18**, as shown in FIG. **13**. When the teeth **130** are inserted in the slots **18**, the tool **120** is rotated to the removal position, as shown in

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FIG. **7**. The tool **120** may also be used to install the disc **12** to ensure the disc is fully seated on onto its mating component.

While exemplary embodiments are described above, it is not intended that these embodiments describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention. Additionally, the features of various implementing embodiments may be combined to form further embodiments of the invention.

What is claimed is:

1. A quick-disconnect fastener assembly comprising:

a mating part comprising:

a hardware portion; and

a fastener portion extending opposite the hardware portion and having a cylindrical shank extending along a longitudinal direction, the shank having a retention feature; and

a fastener disc with a central opening having an inner contact surface, wherein the fastener disc is pushed onto the shank and retained in a locked position when the inner contact surface engages the retention feature on the shank, and

wherein the fastener disc is disconnected from the mating part by rotation of the disc a partial turn to a release position thereby releasing the inner contact surface from the retention feature and then pulling the fastener disc in the longitudinal direction of the shank to be removed from the cylindrical shank.

2. The quick-disconnect fastener assembly of claim 1, wherein the fastener disc is turned generally an eighth-turn to the release position.

3. The quick-disconnect fastener assembly of claim 1, wherein the retention feature comprises at least one groove, wherein when the fastener disc is pushed onto the shank, the inner contact surface of the fastener disc is deflectable and then snaps into engagement with the groove and is retained with an interference fit so the fastener disc is retained on the shank of the mating part in the locked position when the inner contact surface engages the groove.

4. The quick-disconnect fastener assembly of claim 1, further comprising at least one elongated rib along the shank in the longitudinal direction, wherein in the release position, the rib causes the inner contact surface to deflect and disengage the retention feature on the shank.

5. The quick-disconnect fastener assembly of claim 4, wherein the elongated rib has drafted sides that act as a cam surface when the fastener disc is rotated.

6. The quick-disconnect fastener assembly of claim 4, wherein the retention feature comprises a plurality of grooves, and the elongated rib extends perpendicular to the grooves.

7. The quick-disconnect fastener assembly of claim 4, wherein the fastening disc has a chamfered opening, wherein a chamfer angle of the chamfered opening is generally equal to a draft angle of the drafted sides along the elongated rib.

8. The quick-disconnect fastener assembly of claim 4, further comprising a radial opening extending radially from the central opening, wherein the elongated rib is aligned with the radial opening when fastener disc is in the locked position.

9. The quick-disconnect fastener assembly of claim 1, wherein the hardware portion of the mating part comprises at least one of a hook or fastener head.



**10.** The quick-disconnect fastener assembly of claim **1**, wherein the retention feature comprises at least one annular groove.

**11.** A fastener method comprising:

providing a fastening portion with a cylindrical shank 5  
with a plurality of annular grooves formed along a length of the shank and a plurality of elongated ribs oriented along the shank that extend perpendicular to and intersecting the grooves;

providing a fastener disc with a plurality of deflectable 10  
tabs wherein an inner edge of each deflectable tab defines a central opening of the fastener disc with a diameter less than a cylindrical shank diameter;

inserting the fastening portion into the central opening of 15  
the fastener disc; and

pushing the fastening portion to a locked position where 20  
the deflectable tabs are engaged with one of the plurality of grooves with an interference fit.

**12.** The method of claim **11**, further comprising rotating 25  
the fastener disc to a release position so that the elongated rib contacts the inner edge of the deflectable tabs to disengage the tabs from the grooves.

**13.** The method of claim **12**, wherein in the release 30  
position, the rib causes the contact surface to deflect so that the diameter of the central opening is greater than the cylindrical shank.

**14.** The method of claim **12**, further comprising rotating  
the fastener disc generally an eighth-turn to the release position.

**15.** The method of claim **11**, further comprising a radial 35  
opening extending from the central opening and defined between each of the tabs, the method further comprising aligning the elongated rib with the radial opening when the fastener disc is in the locked position.

**16.** The method of claim **11**, wherein the at least one groove comprises a plurality of annular grooves formed along the length of the cylindrical shank.

**17.** The method of claim **16**, further comprising rotating the fastener disc generally an eighth-turn to the release position.

**18.** The method of claim **16**, wherein the shank has a plurality of elongated ribs that extend perpendicular to and intersecting the groove, wherein in the release position, the rib causes the contact surface to deflect so that the central opening is disengaged with the groove.

**19.** The method of claim **16**, further comprising rotating the fastener disc generally an eighth-turn to the release position.

**20.** A fastener method comprising:

providing a fastening portion with a cylindrical shank 40  
with at least one groove formed along a length of the shank;

providing a fastener disc having a central opening of the fastener disc;

inserting the central opening of the fastener disc with the shank; and

pushing the fastener disc in a longitudinal direction of the shank to a locked position, wherein in the locked position, the central opening is engaged with the at least one grooves with an interference fit;

rotating the fastener disc a partial turn to a release position;

after rotating the fastener disc, pulling the fastener disc in a longitudinal direction of the shank without rotating to remove the fastener disc from the shank.

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